

# CINNAMON SURVEY

## Special Report

Cinnamon bark and cassia essential oils are regarded as high risk for adverse skin reactions by dermatologists and aromatherapists, yet they are widely used by consumers. How dangerous are these oils, and what is the real prevalence of adverse events among users? The Tisserand Institute conducted a survey to get a better clinical picture.



The results of an online survey conducted in  
May & June 2015

**A Special Report by the Tisserand Institute**

Kelly Ablard PhD, Christine Carson PhD, Robert Tisserand

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## Contents

3	Summary
4	Background
4	Overview of results
5	Application frequency
6	Dilution
7	Adverse reaction symptoms
8	Time elapsed between application and reaction
8	Ratio of cinnamon bark to cassia users
9	Health status
9	Age and gender profile
10	Discussion
12	Limitations
13	Conclusions
14	Note on statistics
15	References
16	Acknowledgements

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Cinnamon Survey Report

The results of an online survey conducted in May & June 2015

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## Summary

The Tisserand Institute conducted a survey in order to find out whether people who use essential oils on their skin are experiencing adverse reactions, the nature of any adverse reactions, how the oils were used, and how frequent such incidents might be. We selected cinnamon bark and cassia oils for this survey, since they are both high in cinnamaldehyde, and this constituent is regarded as a potential irritant and allergen by dermatologists.

In our survey, we found a very high incidence (27%) of self-reported adverse reactions to these essential oils. We found that using undiluted essential oil on the skin may increase the risk of adverse reaction. We also found that people with seasonal allergies may be more prone than average to adverse skin reactions to cinnamon bark and cassia essential oils.

Our findings suggest that, for many brands, there are insufficient safety guidelines on the labels of these essential oils. Label information was not part of our survey, but we believe that advising dilution without specifying the recommended amount of dilution, which seems to be common, may not provide sufficient protection for consumers for these two oils. We suggest that a recommended maximum dilution in the 0.1 – 1% range should be adopted.



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## Background

Cinnamon bark (*Cinnamomum verum*, Lauraceae) and cassia (*C. cassia*, Lauraceae) essential oils both contain about 75% of cinnamaldehyde, a chemical constituent regarded as an irritant and a potential allergen based on the results of patch testing on thousands of dermatology patients. The fragrance industry guideline to avoid allergic reactions in consumers is for products to contain no more than 0.05% cinnamaldehyde, which means diluting to less than 0.1% for these essential oils. In spite of these guidelines, both essential oils are widely sold in the USA in undiluted form, and perhaps with insufficient safety information. (Note that cinnamon LEAF is a very different essential oil to cinnamon BARK, and it contains only about 1% of cinnamaldehyde.)

In May 2015 we appealed to potential respondents through our mail list and also through public posts on Facebook. We encouraged people to share their experience with topical usage of either cinnamon bark or cassia oil. The initial instruction was:

“Complete the survey if you used one of these [cinnamon bark or cassia] as a single oil, either diluted or undiluted, but not if you blended it with other essential oils, or used a blend containing cinnamon bark or cassia oil. Do use this survey to report your own intentional use of cinnamon bark oil or cassia oil on yourself, but do not report an accidental spillage or use on another person. This survey does not apply to cinnamon LEAF oil.”

We were only looking for reports from intentional topical use (not accidental spillage). You can see the wording of the survey instruction [HERE \(http://tisserandinstitute.org/safety/cinnamon-oil-survey/\)](http://tisserandinstitute.org/safety/cinnamon-oil-survey/). Between May 15th and July 3rd 2015 we received 345 responses. The survey consisted of 15 questions, and for anyone who experienced an adverse reaction there were an additional 10 questions.

Respondents were also asked about dilution, frequency of use and other related application questions. In adverse reaction cases, we asked questions about the symptoms, and the time elapsed between application and reaction, and about other conditions and allergies.

## Overview of results

From a total of 345 responses, 55 (16%) were excluded from the analyses, because they did not meet our criteria for inclusion. The main reason for exclusion was that other oils were used at the same time as cinnamon bark or cassia; this reason accounted for 38% of excluded reports, followed by 24%, who took the oil orally. Disregarded responses included: “I used cinnamon leaf oil one part in total of 13 essential oils” and “1-2 drops in a tsp of carrier oil with other EOs.” and “Taken in a gel cap” and “One drop in warm water. I drank it.” Other excluded reports included instances where the essential oil was diffused and not applied directly to the skin.



One of the excluded reports was from the addition of two drops of cinnamon bark oil that were well mixed into a 16 oz bottle of shampoo – approximately 0.03%. This case was excluded because two drops of peppermint oil were added at the same time as the cinnamon oil, but we are showing it here because it is the only photographic evidence we have of a probable cinnamon bark oil reaction (Figure 1). In another excluded reaction cinnamon oil was applied to the female genital area, resulting in a severe reaction and a visit to the emergency room: “I was extremely anxious that it was a genital wart and read that cinnamon oil could mitigate it. In hindsight it was impossible that it was a genital wart but my anxiety had gotten the better of me. Hence also applying cinnamon oil NEAT to my genitalia!” We specifically excluded the genital area from our survey, because it is especially sensitive to insult.

This left 290 valid responses, out of which 204 people used diluted EO, and 86 used undiluted EO. Out of the 290 total, 213 respondents had no reaction, while 77 reported an adverse reaction. See Table 1, and Figures 2, 3, 4 and 5 for a breakdown of these results.

**Figure 1.**  
**A skin reaction after essential oils were added to a shampoo**



**Table 1.**

Dilution category	Reactions		No reactions		Totals	
	Number	Percent	Number	Percent	Number	Percent
Diluted	48	24%	156	76%	204	100%
Undiluted	29	34%	57	66%	86	100%
<b>All reports</b>	<b>77</b>	<b>27%</b>	<b>213</b>	<b>73%</b>	<b>290</b>	<b>100%</b>

## Application frequency

Sixty-six percent (51/77) of respondents who had a reaction experienced it after applying the oil only once and 34% (n = 26) experienced reactions after using it more than once (Table 2).

**Table 2.**

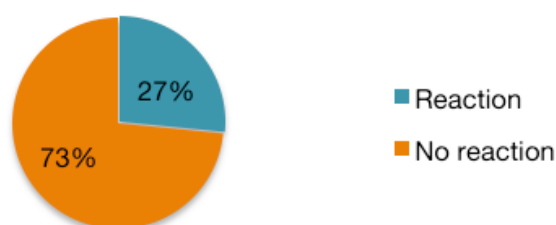
Dilution Category	Application Frequency		Total
	Once	More than once	
Diluted	28	20	48
Undiluted	23	6	29
<b>Total</b>	<b>51</b>	<b>26</b>	<b>77</b>

These data not only show an overall high incidence of reactions (27%) (Figure 2), but also an increased probability of having an adverse reaction (34%) (Figure 4) after applying undiluted oils compared to diluted oils (24%) (Figure 3) to the skin. Figure 5 shows percentage breakdown for all the reports illustrated in Figure 2.

We gave respondents the option to give brand names and many did, though we have not included this information in our report. It is not surprising that the most frequently listed brands in all categories are also widely sold brands. In the reaction/undiluted category, just two brands constituted 9 (26.5%) of the 34 reports.

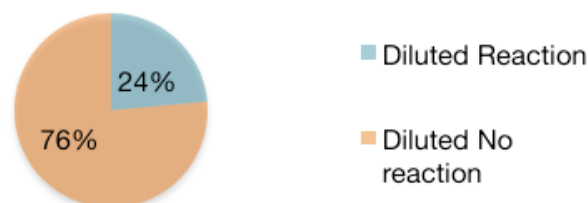
**Figure 2.**

### Total reports (n=290)



**Figure 3.**

### Reports of diluted use (n=204)

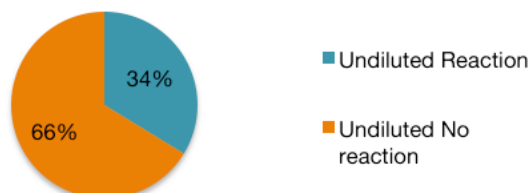


## Dilution

We were either given, or were able to calculate, the concentrations of oil used for 25 out of 48 respondents in the diluted/reaction category, and 69 out of 156 respondents in the diluted/no reaction category. For example, if a respondent mentioned using one drop of essential oil in a tablespoon of carrier oil, the percentage was calculated based on the assumption that 30 drops of essential oil equals 1 mL, and that a tablespoon equals 15 mL. Therefore, 1 drop in a tablespoon is a 0.2% dilution ( $15 \text{ mL} = 450 \text{ drops}$ ,  $1/450 \times 100 = 0.2$ ). Further calculation predicted that people who use a dilution of less than 1% are 28% less likely to have an adverse reaction.

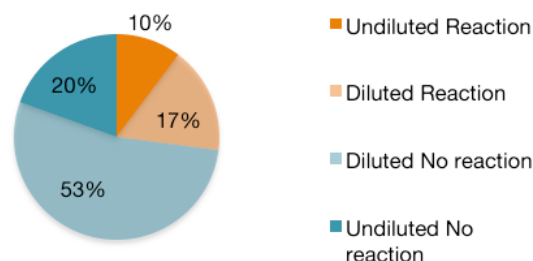
**Figure 4.**

### Reports of undiluted use (n=86)



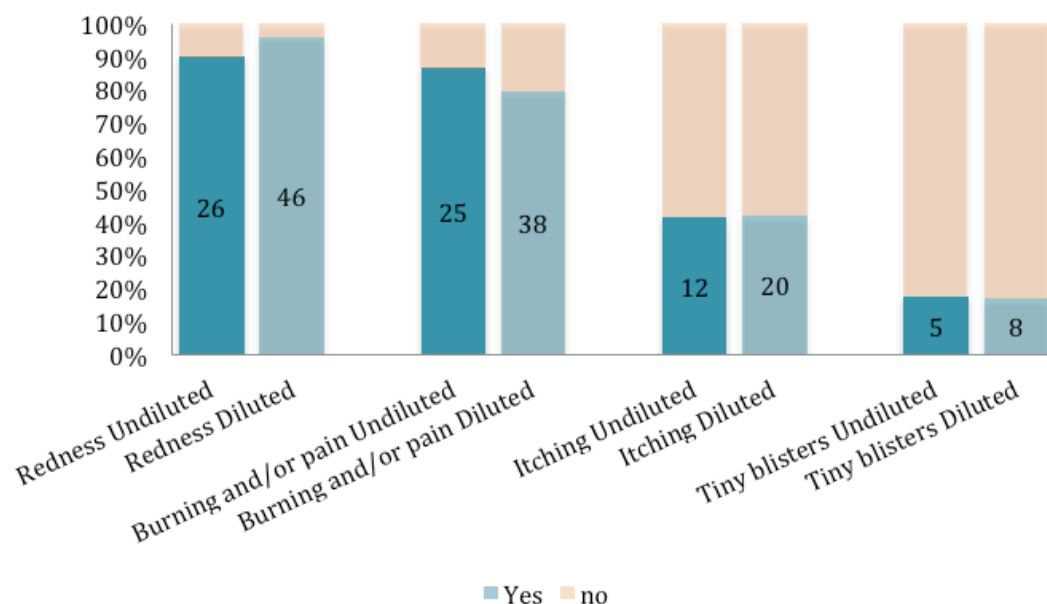
**Figure 5.**

### Total reports of use (n=290)



**Figure 6.**

**Symptoms shown both as numbers of individuals reporting them and percentages**



## Adverse reaction symptoms

The survey asked about the following symptoms: a) redness, b) burning and/or pain, c) itching and d) tiny blisters. More than one answer was allowed. Other symptoms could also be reported in an “other” comment box.

Figure 6 shows the number of respondents reporting individual symptoms categorized by a reaction to a diluted (n=48) or undiluted (n=29) essential oil. Note that in some surveys, the same respondent reported more than one symptom.

The most common symptom was redness. This symptom occurred in 90% of respondents with an adverse effect who used undiluted oil and 96% of respondents who used diluted oil. The frequencies of reported symptoms was very similar for both undiluted and diluted oil usage, although we cannot deduce anything from this about the type of reaction.

In one case, a person was advised to use cassia oil, diluted to 10% in vegetable oil. This person reported: “Recovered from intestinal superbacteria, advised to use cassia to prevent recurrence and aid digestive recovery.” A few drops of the diluted oil were applied to the abdomen and feet three times daily. After two weeks of using the oil, and 1-2 hours after an application, there were skin reactions in all three areas, involving redness, burning and/or pain, itching and tiny blisters.

## Time elapsed between application and reaction

Another question of the survey was targeted at how much time elapsed between the use of the oil and occurrence of the adverse reaction. Seventy-nine percent of respondents (59/75) found that the reaction began within 15 minutes of applying the essential oil (Table 3).

Table 3.

Dilution Category	Time between application and reaction					Total
	<i>Within 15 minutes</i>	<i>15-60 minutes</i>	<i>1-2 hours</i>	<i>The next morning</i>	<i>After a few days</i>	
Diluted	36	2	5	2	1	46
Undiluted	23	3	0	2	1	29
Total	59	5	5	4	2	75

## Ratio of cinnamon bark to cassia users

We asked for responses to both cinnamon bark oil and cassia oil because these oils are very similar in their chemical composition, both being high in cinnamaldehyde. Many more respondents (76%) had used cinnamon bark oil than cassia (21%), with another 3% who used one of the oils, but could not remember which one (Table 4). Similar ratios are reflected in all the data, except for reactions from undiluted oil. In this case the ratio was 85/12/3, though this may simply be because of the low numbers for cassia oil and reactions (Table 5). The general similarity of these ratios suggests similar risks for skin reactions to both oils, which is likely due to their similarity in composition. The major constituent of both the oils is cinnamaldehyde (73 - 89% for cassia, 63 - 76% for cinnamon bark oil). Dermatologists consider cinnamaldehyde to be a potential skin irritant and allergen (Tisserand and Young, 2014, pages 235-236, 248-249, 527-531).

Table 4.

Essential Oil	Total respondents		Total No Reaction		Total Reaction	
Cinnamon bark	221	76%	164	77%	57	74%
Cassia	61	21%	45	21%	16	21%
Don't know	8	3%	4	2%	4	5%
Total	290	100%	213	100%	77	100%

**Table 5.**

Essential Oil	Reaction				No reaction			
	Diluted		Undiluted		Diluted		Undiluted	
Cinnamon bark	29	66%	28	85%	123	78%	41	73%
Cassia	12	27%	4	12%	31	20%	14	25%
Don't know	3	7%	1	3%	3	2%	1	2%
Total	44	100%	33	100%	157	100%	56	100%

## Health status

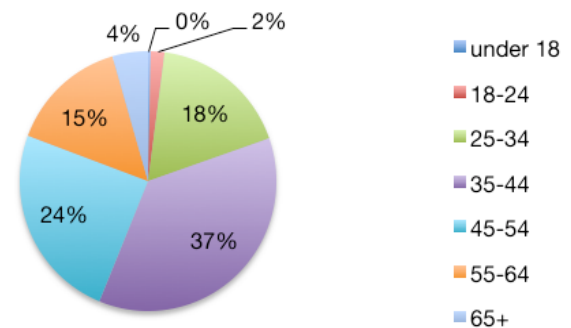
One specific question, asked only of those that reported a reaction, was whether respondents experience “seasonal allergy symptoms”. We were looking for a possible correlation between skin reactions (which are often allergic) and respiratory allergy. With hindsight, this question should have been asked of non-reactors as well for comparison, but we did not do this. Of the 77 reactors, 36 (47%) reported also having seasonal allergies. This does seem high, since only 8% of the US adult population is considered to have seasonal allergies (defined as hay fever or allergic rhinitis) <http://www.stvincent.org/Health-Library/Greystone-Adult/Allergy-and-Asthma-Statistics.aspx>.

## Age and gender profile

Out of the 290 valid survey submissions, the vast majority (92.4%) were from female respondents. This could likely be attributed to the overall prevalence of female users in the field of aromatherapy. Respondents represented all adult age groups, as can be seen in Figure 7.

**Figure 7.**

### Age profile of respondents



# Discussion

Skin reactivity is concentration-dependent: the greater the concentration of allergen in a substance, the higher the risk (Frosch et al 2005). Therefore it should be possible to apply potential allergens to the skin safely, so long as they are incorporated at concentrations well tolerated by most individuals. Table 6 shows the results of a series of patch tests on individuals who were known to be allergic to cinnamaldehyde. As the concentration of cinnamaldehyde is reduced, the number of people reacting decreases from 100% to zero (Johansen et al 1996). Concentration dependency has also been reported for whole essential oils, for example frankincense, geranium, peppermint and eucalyptus, when used in patch testing (Selvaag et al 1995).

**Table 6.**  
**Cinnamaldehyde patch tests on 18 dermatitis patients known to be sensitive to a 2% dilution of cinnamaldehyde (not part of our survey)**

Concentration of cinnamaldehyde	Percentage of people who reacted	Number of reactors
2.0%	100%	18/18
1.0%	83%	15/18
0.5%	61%	11/18
0.1%	27%	5/18
0.05%	17%	3/18
0.02%	6%	1/18
0.01%	0%	0/18

In our survey, 27% of those who used cinnamon bark or cassia oil reported an adverse reaction. Because of survey bias, it is likely that the real figure is somewhat lower than this. Since 1995, 270 of 14,007 dermatitis patients (1.93%) who were patch tested with a 1% concentration of cinnamaldehyde had a positive (i.e. adverse) reaction to it (Belsito et al 2006, Frosch et al 1995, Heisterberg et al 2011, Marks et al 1995, Schnuch et al 2007, Warshaw et al 2015). Since patch testing exaggerates risk compared to real-world use (for example by not allowing evaporation, and only by testing those who visit a dermatologist about a skin problem), the prevalence of cinnamaldehyde allergy in the general population is probably less than 1.9%. However, using greater than 1% in patch testing increases the number of adverse reactions significantly.

According to IFRA guidelines [www.ifraorg.org/view\\_document.aspx?docId=23297](http://www.ifraorg.org/view_document.aspx?docId=23297) the risk of skin allergy from cinnamaldehyde can be mitigated by adhering to the recommended safety standards for dilution (to a concentration of 0.05% or less for cinnamaldehyde, equivalent to 0.07% for cinnamon bark oil). However, although we found that diluting the essential oil to less than 1% did reduce risk, we also saw some cases of adverse reaction to cinnamon bark oil at less than 0.07%. In Europe, the recommended maximum for cinnamaldehyde in leave-



on personal care products is 0.001%, and most widely-used cosmetics in the Western world contain no more than this.

In contrast to these guidelines, our survey showed that aromatherapy enthusiasts are intentionally applying cinnamon bark oil to their skin at very much higher concentrations, sometimes even undiluted. Since adverse skin reactions are concentration-dependent, aromatherapy enthusiasts may represent a high-risk group.

Comparison of patch testing results with our own survey is problematical, as these reports summarize results of studies done on people who met different criteria. However, whether the actual number of people who react adversely to cinnamon bark oil is 2% or 27%, any number in this range is high.

Apart from photosensitization, there are three possible types of adverse skin reaction to essential oils:

- 1. Irritation (Irritant contact dermatitis)**
- 2. Contact urticaria (immediate hypersensitivity)**
- 3. Allergic contact dermatitis (delayed hypersensitivity)**

We cannot be sure which type of reaction individual respondents experienced, and cinnamaldehyde can cause all of these. Irritation is the least problematic, and the reaction would die down quite quickly after the oil is removed from the skin, though it is still unpleasant and undesirable. Contact urticaria is the type of reaction caused by an insect bite, and it causes a characteristic “wheal and flare” response (see Figure 8). A key element in contact urticaria is the release of histamine, and histamine release caused by cinnamaldehyde was first observed by Nater et al in 1977.

Contact urticaria can either be immunological (IgE-mediated) (immunological contact urticaria, or ICU), or non-immunological (NICU). Cinnamaldehyde is one of the few well-known causes of NICU (Safford et al 1990). ICU can involve the respiratory system or the gastrointestinal tract, and it can cause anaphylactic shock, which in turn may be fatal (Bhatia et al 2009, Davari & Maibach 2010). One non-fatal case of probable anaphylaxis to cinnamaldehyde has been reported (Diba & Statham

**Figure 8. Contact urticaria**



2003). We are not aware of any cases of anaphylaxis to cinnamon bark oil or cassia oil, so this remains a remote but possible risk.

Allergic contact dermatitis is the most common type of reaction to fragrance substances. As with ICU, it does not occur the first time the skin is exposed to the substance. In a recent report, 3.9% of 4,238 dermatitis patients who were patch tested with cinnamaldehyde had a positive (i.e. allergic) reaction (Warshaw et al 2015).

In our survey, two thirds of respondents reported a reaction after only one application of the essential oil. This suggests that many of the reactions were either irritation or NICU, since the other types of skin reaction require more than one exposure. For example, of the 29 reactions to undiluted oil, 23 people reported using it only once.

In one sense, the type of reaction is irrelevant, as adverse events are always undesirable. An allergic reaction is most definitely something to be avoided. Once the immune system builds a response to an allergen, it reacts to the same substance on subsequent exposures. And, even an initial irritant reaction can eventually give rise to an allergic reaction with repeated application.

The potential link that we saw with seasonal allergies is intriguing, and merits further investigation. Both ICU and allergic rhinitis are IgE-mediated immune responses, and there may be a genetic predisposition that they share, although we appreciate that so far, such genetic factors have not been identified in either case.

## Limitations

It is possible that people who had an adverse reaction were more likely to complete our survey than those that did not, and we have no accurate way to account for this. We can say that nearly 3 times more people who completed the survey did not have a reaction, so clearly many non-reactors were motivated to respond. Another limitation is inherent in self-reporting – we assume that everything respondents tell us is correct, and we have no way to fact check.

In particular, we were reliant on respondents' information about the oil they used. We were not able to confirm the provenance or purity of any of the oils or account for the manner in which they had been stored. All of these factors can influence adverse reactions that may occur when essential oils are used. Given the scope for adulteration, mislabeling or oxidation, this limitation must be borne in mind when considering the survey results.

As already stated, data from our survey are not directly comparable to previous reports in the medical and scientific literature because they are based on a very different population from other studies. Most previous studies are based on data from patients referred by their doctor to specialist dermatologists or immunologists. Our population was a self-selected group of individuals who self-diagnosed the presence or absence of an adverse reaction.



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## Conclusions

In spite of the limitations outlined above, several conclusions are possible from our survey.

**1. Consumers who apply essential oils to their skin can have adverse reactions to them. It is often perpetuated that, since essential oils are natural substances, the human body cannot adversely react to them.**

Any adverse reaction symptoms are thus dismissed as detoxification (see <http://tisserandinstitute.org/essential-oils-and-the-detox-theory/>). Our survey has shown that adverse reactions to essential oils can and do happen. And these reactions occurred quite rapidly, with 79% of respondents reporting that symptoms occurred within 15 minutes of application.

**2. There was a very high incidence of reported adverse reactions to essential oils identified by users as cinnamon bark or cassia.**

Adverse reactions were reported by 27% of those who completed the survey and met the inclusion criteria. Even allowing for the possibility that those experiencing an adverse reaction may be more likely to complete such surveys, this is a remarkably high percentage, and suggests that applying cinnamon bark or cassia oil to the skin carries a significant risk.

**3. Using undiluted essential oil on the skin may increase the risk of adverse reaction. Our survey shows that 10% more people reacted to undiluted than diluted oil, and this was statistically significant ( $p = 0.03$ ) (Table 1 and Figures 3 and 4).**

It is very likely that the greater the dilution, the lower the risk of adverse reaction; however this survey did not provide sufficient data to be able to state what a safe dilution would be. The International Fragrance Association (IFRA) standard, indicates a safety threshold of 0.07%. The fact that almost none of the reported cases (reaction or no reaction) used cinnamon bark or cassia oil at that concentration suggests that concentration may be safe. The frequent use of much higher concentrations, and especially undiluted oil, also suggests that users are not properly informed on or choose not to adhere to safety recommendations.

**4. People with seasonal allergies may be more prone than average to adverse skin reactions to cinnamon bark and cassia essential oils.**

Of the 77 reactors in our survey, 36 (47%) reported also having seasonal allergies. This is high compared to the 8% of the US adult population that is considered to have seasonal allergies (defined as hay fever or allergic rhinitis) <http://www.stvincent.org/Health-Library/Greystone-Adult/Allergy-and-Asthma-Statistics.aspx>.

## 5. The labeling of cinnamon bark and cassia essential oils should always include appropriate safety guidelines.

In the UK, it is a requirement of membership of the Aromatherapy Trade Council that ALL essential oils include on the label instructions not to apply undiluted to the skin <http://www.a-t-c.org.uk/code-of-practice/>. In the USA, usage cautions for the labeling of undiluted essential oils, issued in 2012 by the American Herbal Products Association, require that the following is included: “Do not apply undiluted directly on skin.” An exception is made for direct application in an undiluted state if the marketer has expert support that such use is appropriate and safe for the intended use. [http://www.ahpa.org/Default.aspx?tabid=223#section\\_essentialoils](http://www.ahpa.org/Default.aspx?tabid=223#section_essentialoils). In the UK, compliance with the labeling requirement is widespread. Compliance in the USA with the specified wording is rare, though many brands do recommend dilution before topical use. While these guidelines are intended to apply to all essential oils, we feel there is a particular need in the case of cinnamon bark and cassia oils. We suggest that a recommended maximum dilution in the 0.1 – 1% range should be adopted.

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### **Note on statistics**

Data were treated as nominal or ratio measurements and analyzed using Microsoft Excel v.14.0 and IBM SPSS Statistics 21. The p value was set at <0.05 for the inferential statistical analyses. Descriptive statistics were used to compare the frequencies and percentages between grouped cases. Inferential statistics were used to test quantifiable differences of the independence and association between two categorical variables.

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## Cinnamon illustration

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## Figure 1

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## Figure 8

Contact urticaria by James Heilman, MD (Own work) GFDL  
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